CLAIMS

1. A facial image-processing method comprising:

illuminating a face with illumination; and

contemporaneously capturing structure data describing the face's structure and reflectance data describing reflectance properties of the face from the illumination.

2. The method of claim 1, wherein said illuminating comprises using multiple light sources.

3. The method of claim 2, wherein one of the light sources projects a pattern on the face from which the structure data can be ascertained.

4. The method of claim 2, wherein one of the light sources comprises an infrared light source.

5. The method of claim 2, wherein all of the light sources comprise infrared light sources.

6. The method of claim 1, wherein said illuminating comprises using multiple polarized light sources.

7. The method of claim 1, wherein said illuminating comprises illuminating the face with light sources at different frequencies.

8. The method of claim 1, wherein said capturing comprises using a camera having a polarizer that suppresses specularly-reflected light so that diffuse component reflection data is captured.

9. The method of claim 8, wherein one of the light sources projects a pattern on the face from which the structure data can be ascertained.

10. The method of claim 9, wherein the one light source comprises an infrared light source.

11. The method of claim 1, wherein said illuminating comprises illuminating the face with multiple narrow-band light sources.

12. A facial image-processing method comprising:

illuminating a face with a first polarized light source that is selected so that specularly-suppressed reflective properties of the face can be ascertained;

illuminating the face with a second structured light source that projects a pattern onto the face, while simultaneously illuminating the face with the first polarized light source;

capturing both specularly-suppressed reflection data and structure data from the simultaneous illumination.

13. The method of claim 12, wherein the light sources provide light at different frequencies.

14. The method of claim 12, wherein the light sources provide infrared light.

15. The method of claim 12 further comprising processing the captured data to provide both (a) data that describes dimensional aspects of the face and (b) data that describes diffuse reflective properties of the face.

16. The method of claim 15, wherein the data that describes the diffuse reflective properties of the face comprises an albedo map.

17. A facial image-processing method comprising:

illuminating a face with multiple different light sources;

measuring range map data from said illuminating;

measuring image data from said illuminating;

deriving a 3-dimensional surface from the range map data;

computing surface normals to the 3-dimensional surface; and

processing the surface normals and the image data to derive an albedo map.

18. The method of claim 17, wherein at least one of the light sources is polarized.

19. The method of claim 17, wherein all of the light sources are polarized.

20. The method of claim 17 further comprising after said measuring of the range map data, applying a generic face template to the range map data to reject noise that is associated with the range map data.

21. The method of claim 17 further comprising prior to deriving the 3-dimensional surface, filtering the range map data.

22. A facial image-processing method comprising:

receiving range map data and image data that are generated from a simultaneous facial illumination;

deriving a 3-dimensional surface from the range map data;

computing surface normals to the 3-dimensional surface; and

processing the surface normals and the image data to derive an albedo map.

23. One or more computer-readable media having computer-readable instructions thereon which, when executed by a computer, implement the method of claim 22.

24. A facial image processing system comprising:

a facial illumination system that is configured to provide multiple different light sources at the same time for illuminating a subject's face; and

a data-capturing system configured to capture both structure data and reflectance data from the subject's face when illuminated by the facial illumination system.

25. The system of claim 24, wherein the illumination system comprises at least one polarized light source.

26. The system of claim 24, wherein the illumination system comprises multiple polarized light sources.

27. The system of claim 24, wherein the illumination system comprises a patterned light source configured to project a pattern onto the subject's face.

28. The system of claim 27, wherein the patterned light source comprises an infrared light source.

29. The system of claim 24, wherein the different light sources are all infrared light sources.

30. The system of claim 24, wherein at least one of the different light sources comprises an infrared light source.

31. The system of claim 24, wherein the different light sources are selected to comprise narrow-band light sources.

32. A facial image processing system comprising:

multiple different light sources, one of which providing structured light that can be projected onto the face of a subject, another of which providing light from which specularly-suppressed, diffuse reflectance data from the subject's face can be ascertained;

a camera configured to capture structure and reflectance data from an illumination of the subject's face with the multiple different light sources; and

a computerized image processor configured to process the structure and reflectance data to provide an albedo map that describes specular-suppressed diffuse reflectance properties of the subject's face and dimensional data that describes dimensional aspects of the subject's face.

33. The system of claim 32, wherein the computerized image processor is configured to:

measure range map data;

compute a 3-dimensional surface from the range map data;

compute surface normals to the 3-dimensional surface; and

derive the albedo map from the surface normals and the reflectance data.

34. The system of claim 33, wherein the computerized image processor is configured to filter the range map data prior to deriving the 3-dimensional surface.

35. The system of claim 34, wherein the computerized image processor filters the range map data by applying a generic face template to the data.

36. A facial image processing method comprising:

illuminating a subject's head with one or more light sources that are selected to suppress specular reflection;

capturing digital images from a plurality of positions around the subject's head while the subject's head is illuminated;

computing an albedo map for each of the digital images; and

combining two or more of the computed albedo maps for the digital images to provide a single albedo map for the subject's head.

37. The facial image processing method of claim 36, wherein the light sources provide polarized light.

38. The facial image processing method of claim 37, wherein said capturing comprises using a digital camera that has a complementary polarizer configured to remove the specularity.

39. The facial image processing method of claim 36, wherein said combining comprises computing a weighted average of individual albedo maps.

40. The facial image processing method of claim 39, wherein said computing of the weighted average comprises using a weighting function that gives higher weights to pixels that are viewed and/or illuminated from directions nearly normal to the surface of the subject.

41. The facial image processing method of claim 36, wherein said computing comprises:

for each pixel in a texture map:

computing a surface normal;

computing the irradiance;

computing the viewing direction; and

computing coordinates in image space; and

computing the Lambertian reflectance for one or more of the pixels.

42. The facial image processing method of claim 36, wherein said computing comprises, prior to computing an albedo for a particular pixel, verifying that the pixel is visible and suitably illuminated.

43. The facial image processing method of claim 42 further comprising designating each pixel as having different degrees of visibility and illumination and computing an albedo for a pixel only if the pixel is fully visible, fully illuminated by at least one light source, and not partially illuminated by any light source.

44. A facial image-processing system comprising:

a camera;

multiple light sources that produce light selected to suppress the specular reflection of a subject's head that is viewed by the camera; and

an image processor configured to:

receive multiple digital images of a subject's head that are produced by the camera;

compute an albedo map for each image;

combine albedo maps for all of the images to provide a single albedo map for the subject's head.

45. The facial image processing system of claim 44, wherein the image processor combines the albedo maps by computing a weighted average of the individual albedo maps.

46. The facial image processing system of claim 45, wherein the image processor computes the weighted average of the individual albedo maps by using a weighting function that gives higher weights to pixels that are viewed and/or illuminated from directions nearly normal to the surface of the subject.